

TITLE OF THE INVENTION

INFORMATION RECORDING APPARATUS, INFORMATION RECORDING
METHOD, INFORMATION REPRODUCTION APPARATUS,
INFORMATION REPRODUCTION METHOD, INFORMATION
5 RECORDING MEDIUM, AND ELECTRONIC DISTRIBUTION SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is based upon and claims the
benefit of priority from the prior Japanese Patent
Application No. 2000-264385, filed August 31, 2000, the
10 entire contents of which are incorporated herein by
reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an information
15 recording method and apparatus for recording a
compressed object (content) and the like on an
information recording medium.

The present invention also relates to an
information reproduction method and apparatus for
20 reproducing an information recording medium on which
a compressed object and the like are recorded.

The present invention also relates to an
information recording medium on which a compressed
object and the like are recorded.

25 The present invention also related to
an electronic distribution system for distributing
a compressed object and the like.

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2. Description of the Related Art

The DVD forum issued a standard capable of recording/reproducing video information on/from an information recording medium.

5 Video information has a unit called a "recording unit" or "title corresponding to program unit" which divides large video contents. In the above standard, a management unit called "video object" is used for the "recording unit", and a management
10 unit called "program" is used for the "program unit or title".

 The DVD forum is currently examining an audio recording standard, i.e., a standard capable of recording/reproducing audio information highly
15 compatible with the above video recording standard.

 In the video recording standard, video data is compressed by MPEG2 and recorded, and audio data is recorded by linear PCM without any compression, or compressed by MPEG audio or AC-3 and recorded.
20 In addition to the above audio compression schemes, various kinds of audio compression schemes exist, including AAC, MP3, ATRAC3, WMA, DTS, Twin-VQ, and Q Design. When a plurality of compression schemes are selected as the audio recording standards, an audio
25 recording compatible recorder only need to have an encoder of at least one of the compression schemes. However, a compatible player must have decoders of all

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compression schemes to keep the compatibility.
In addition, in supporting a new compression scheme to
be developed in the future, the compatibility cannot be
ensured.

5 BRIEF SUMMARY OF THE INVENTION

The present invention has been made in
consideration of the above situation, and has as its
object to ensure compatibility with various kinds of
compression schemes.

10 In order to solve the above problem and achieve
the above object, an information recording apparatus,
information recording method, information reproduction
apparatus, information reproduction method, information
recording medium, and electronic distribution system
15 according to the present invention have the following
arrangements.

(1) An information recording apparatus of the
present invention comprises generation means for
generating manager information representing a
20 correspondence between a compressed content and a
program for expanding the content, and recording means
for recording the content, program, and manager
information on an information recording medium.

(2) An information recording method of the
25 present invention comprises the steps of generating
manager information representing a correspondence
between a compressed content and a program for

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expanding the content, and recording the content, program, and manager information on an information recording medium.

5 (3) An information reproduction apparatus of the present invention comprises read means for reading out, from an information recording medium, manager information representing a correspondence between a compressed content and a program for expanding the content and reading out the content and program on the basis of the manager information, and reproduction means for expanding and reproducing the content on the basis of the program read by the read means.

10 (4) An information reproduction method of the present invention comprises the steps of reading out, from an information recording medium, manager information representing a correspondence between a compressed content and a program for expanding the content, reading out the content and program on the basis of the manager information, and expanding and reproducing the content on the basis of the readout program.

15 (5) An information recording medium of the present invention comprises a content recording area in which a compressed content is recorded, a program recording area in which a plurality of programs corresponding to a plurality of compression schemes are recorded together, each of the programs expanding

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the compressed content, and a manager information recording area in which the manager information representing a correspondence between the compressed content and the program for expanding the content is recorded.

(6) An electronic distribution system of the present invention simultaneously distributes a compressed content and a program for expanding the content.

Additional objects and advantages of the present invention will be set forth in the description which follows, and in part will be obvious from the description, or may be learned by practice of the present invention. The objects and advantages of the invention may be realized and obtained by means of the instrumentalities and combinations particularly pointed out hereinafter.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate embodiments of the present invention and, together with the general description given above and the detailed description of the embodiments given below, serve to explain the principles of the present invention.

FIG. 1 is a view showing an electronic music distribution (EMD) system used by a record company and

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FIG. 3 is a view showing the data structure of an information recording medium according to the present invention and the recording position (first example) of manager information representing the correspondence between a compressed audio object and a decode program;

FIG. 5 is a view showing the data structure of the information recording medium according to the present invention and the recording position (third example) of manager information representing the correspondence between a compressed audio object and a decode program:

FIG. 7 is a view showing the file structure of the information recording medium according to the present invention and an example in which a plurality of decode programs are managed by a plurality of files.

respectively;

FIG. 8 is a flow chart showing processing of recording, on the information recording medium, a compressed object, a decode program for decoding the compressed object, and manager information representing the correspondence between the compressed object and the decode program;

FIG. 9 is a flow chart showing processing of reproducing the information recording medium on which the compressed object, the decode program for decoding the compressed object, and the manager information representing the correspondence between the compressed object and the decode program are recorded;

FIG. 10 is a view showing the data structure of a decode program recording area;

FIG. 11 is a view showing the data structure of decode programs (DEC_PG);

FIG. 12 is a view showing a compression scheme code list; and

FIG. 13 is a view showing the data structure of a DEC_PG in A_ATTR.

DETAILED DESCRIPTION OF THE INVENTION

The embodiment of the present invention will be described below with reference to the accompanying drawing.

FIG. 1 is a view showing an electronic music distribution (EMD) system used by a record company and

the like.

A user requests an electronic music sale site operated by a content distributor or the like to distribute a content. An authentication/charging server receives the distribution request from the distributor, charges the user for distribution, and sends a distribution permission to a content server. The user receives a decryption key from the authentication/charging server and an encrypted content from the content server. The user also acquires a program for decoding the compressed content from either server. The user decrypts the content using the acquired key and decodes the compressed content using the acquired program. With this processing, the user can reproduce the content even when he/she does not know information related to the compression form of the transmitted content as all.

FIG. 2 is a block diagram showing the schematic arrangement of an information recording/reproduction apparatus according to the present invention.

The information recording/reproduction apparatus shown in FIG. 2 records data on an information recording medium (DVD) 100 or reproduces data recorded on the information recording medium 100. As shown in FIG. 2, the information recording/reproduction apparatus comprises a disc drive section 1, temporary storage section 2, D-PRO section 3, digital audio input

section 4, analog video input section 5, data input
section 6, analog audio input section 7, recording
section 8, reproduction section 15, analog audio output
section 26, digital audio output section 27, analog
5 video output section 28, STC section 29, and MAIN MPU
section 30.

The recording section 8 has an A/D conversion
section 9, video encoding section 10, A/D conversion
section 11, audio encoding section 12, and formatter
10 section 13. The formatter section 13 has a memory 14.

The reproduction section 15 has a programmable DSP
LSI 16, separation section 18, audio decoding section
20, subpicture decoding section 21, video decoding
section 22, D/A conversion section 23, V-PRO section
15 24, and D/A conversion section 25. The programmable
DSP LSI 16 has a program area 17. The separation
section 18 has a memory 19.

A video object input from the analog video input
section 5 is A/D-converted by the A/D conversion
20 section 9, compressed by the video encoding section 10,
and formatted into the DVD standard by the formatter
section 13. On the other hand, an audio object input
from the analog audio input section 7 is A/D-converted
by the A/D conversion section 11, compressed by the
25 audio encoding section 12 (or keeps the format at the
time of input without being compressed), and formatted
into the DVD standard by the formatter section 13.

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The objects formatted into the DVD standard are recorded on the information recording medium 100 through the disc drive section 1 in accordance with the standard.

5 An audio object input from the digital audio input section 4 is formatted into the DVD standard by the formatter section 13 while keeping the form at the time of input, and recorded on the information recording medium 100 through the disc drive section 1 in
10 accordance with the standard.

 Simultaneously, manager information related to these objects is generated in the MAIN MPU section 30 and recorded on the information recording medium 100 through the disc drive section 1 in accordance with the
15 standard.

 A decode program input from the data input section 6 is recorded on the information recording medium 100 through the disc drive section 1 in accordance with the standard together with the manager information
20 generated in the MAIN MPU section 30, which represents the correspondence between the compressed objects and the decode program.

 The recording position of the manager information representing the correspondence between the compressed
25 audio object and the decode program will be described next with reference to FIGS. 3 to 5. The manager information representing the correspondence between

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the compressed audio object and the decode program is recorded in a manager information recording area 130 shown in FIGS. 3 to 5. More specifically, there are three examples of the recording position. FIGS. 3 to 5 show the three examples.

FIG. 3 is a view showing the data structure of the information recording medium according to the present invention and the recording position (first example) of the manager information representing the correspondence between the compressed audio object and the decode program.

The format is designed to allow both a general computer information recording area 120 and an audio/video relational information recording area 121 to exist in a data area 112, where the user can record information, in the rewritable disc-like information recording medium 100. In this embodiment, an audio content (audio object) can be reproduced, and simultaneously, a still picture can be displayed. An audio or video content is called an object. An audio content is recorded in an AR audio object recording area 131, and a video object is recorded in an AR still picture object recording area 132. If the recorded audio content is a compressed object, a decode program for decoding the object is recorded in an AR decode program object recording area 133. The contents, attribute information, and control

information for display of these pieces of object information (content information) are recorded in the manager information recording area 130 together.

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5 The information representing the correspondence between the compressed audio object and the decode program for decoding the object is also recorded in the manager information recording area 130. FIG. 12 is a view showing a code list that indicates the compression schemes of compressed audio objects.

10 Each of "0000 0001b" to "1111 1111b" represents that a decode program for a compression scheme shown in FIG. 12 is recorded on the information recording medium, and "0000 0000b" represents that a decode program corresponding to the compression scheme is not

15 present on the information recording medium or no decode program is required to decode the audio object. Each of these codes is stored in a decode program (DEC_PG) 165 of a PGI 151 representing each information of a program (especially a track is represented by the

20 audio recording standard) in an ORG_PGCI 143, so that the compressed audio object can be decoded using different decode programs for the respective programs. The PGI 151 can be regarded as an area where information related to a program based on an audio

25 object (content) is recorded.

FIG. 4 is a view showing the data structure of the information recording medium according to the present

invention and the recording position of manager information (second example) representing the correspondence between the compressed audio object and the decode program.

5 The correspondence is stored in a decode program (DEC_PG) 182 of an AUD_STI 171 in an AUDFIT 141, which manages information of a plurality of audio objects with the same attribute. The codes shown in FIG. 12 are described in an A_ATR 180 of the AUD_STI 171 so as
10 to indicate the compression scheme of the audio object. Data as shown in FIG. 13 are described in a DEC_PG 181. Referring to FIG. 13, "0000 0000b" represents that a decode program corresponding to the compression scheme indicated by the A_ATR 180 is not recorded on
15 the information recording medium, and "0000 0001b" represents that the decode program corresponding to the compression scheme indicated by the A_ATR 180 is recorded on the information recording medium. With this format, the correspondence between the types
20 of the compression scheme of the audio object recorded on the information recording medium and the presence of the decode program corresponding to the compression scheme can be uniquely defined. The AUD_STI 171 can be regarded as an area where information related to the
25 recording scheme of an audio object (content) is recorded.

FIG. 5 is a view showing the data structure of

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the information recording medium according to the present invention and the recording position (third example) of manager information representing the correspondence between the compressed audio object and the decode program.

The correspondence is stored in a decode program (DEC_PG) 196 of an AOB_GI 188 in an AOBI 186 in an AUDFI 175 of the AUDFIT 141, which manages information of each audio object. The codes indicating the compression schemes of compressed audio objects shown in FIG. 12 are described here. Each of "0000 0001b" to "1111 1111b" represents that a decode program for a compression scheme shown in the table is recorded on the information recording medium, and "0000 0000b" represents that a decode program corresponding to the compression scheme is not present on the information recording medium or no decode program is required to decode the audio object. With this format, the presence of a corresponding decode program can be defined for each audio object. In the AOB_GI 188, general information of the audio object (content) is recorded.

Each object (content) is recorded in an independent file in accordance with the contents of the object. That is, as shown in FIG. 6, all audio contents (audio objects) are recorded in an AR_AUDIO.ARO 212 together, and all still pictures are

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recorded in an AR_STILL.ARO 213 together. A plurality of decode programs for decoding compressed audio objects are recorded in an AR_DECOD.PRG 215. Pieces of information in the manager information recording area 130, which systematically manage the object files, are recorded in an AR_MANGR.IFO 211 and its backup file, i.e., an AR_MANGR.BUP 214.

For example, a plurality of decode programs (230, 231, and 232) as shown in FIG. 10 are recorded in the AR_DECOD.PRG 215 together. In this case, the decode programs (DEC_PG) 165, 182, and 196 in the manager information recording area 130 must have information representing the presence of the decode programs and also indicate the areas where the decode programs are recorded.

FIG. 11 is a view showing the data structure of the decode programs (DEC_PG) 165, 182, and 196. Each of the decode programs (DEC_PG) 165, 182, and 196 is formed from three parts: a decode program code 240, start address of decode program 241, and size of decode program 242. The decode program code 240 indicates the presence of the decode program corresponding to the compressed object using the code shown in FIG. 12 or 13, as described above. The start address of decode program 241 indicates the decode program start position as the relative number of bytes from the start position of the AR_DECOD.PRG 215. The size of decode program

242 indicates the size of the decode program as the number of bytes.

FIG. 7 is a view showing another data structure for recording decode programs. The decode programs are recorded in separate files (AR_DEC01.PRG 216 to AR_DECFF.PRG 217). The names of files that record the decode programs and the code table shown in FIG. 12 are in a one-to-one correspondence. For example, when data recorded in the decode program (DEC_PG) 165, 182, or 196 or A_ATR 180 is "0000 0010b", it represents that AR_DEC03.PRG in which the decode program for AC-3 audio is recorded is present. If the data is "0000 1010b", it represents that AR_DEC0A.PRG in which the decode program for Q Design audio is recorded is present.

FIG. 8 is a flow chart showing the recording operation by the information recording/reproduction apparatus.

The information recording/reproduction apparatus shown in FIG. 1 reads manager information from the AR_MANGR.IFO 211 of the information recording medium and loads the manager information to the MAIN MPU section 30 (ST1). If no manager information is present on the information recording medium, new manager information is generated in the MAIN MPU section 30 (ST1). The information recording/reproduction apparatus receives an object to be recorded from the digital audio input section 4 (ST2). The MAIN MPU

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section 30 checks whether the audio object is a compressed object, and if so, specifies the compression scheme (ST3). If the object is a compressed object (YES in ST3), the MAIN MPU section 30 uses the DEC_PG 5 165, 182, or 196 in the manager information (ST4) to check whether a decode program corresponding to the audio object to be recorded is present in the AR_DECOD.PRG 215 (or AR_DEC01.PRG 216 to AR_DECCFF.PRG 217) (ST5). For example, if the audio object to be 10 recorded is in an MPEG audio format, the MAIN MPU section 30 checks whether the AR_DEC02.PRG 216 is present on the information recording medium, or the DEC_PG 165, 182, or 196 which has a DEC_PG = 0000 0010b (a code indicating AC-3 audio) is present in the 15 manager information.

If no corresponding decode program is present on the information recording medium (NO in ST5), the decode program is received from the data input section 6 (ST6). The received decode program is recorded in 20 the AR_DECOD.PRG 215, i.e., AR decode program object recording area 133 (ST7). Alternatively, the decode program is recorded as one file such as AR_DEC02.PRG. Simultaneously, the value of the DEC_PG 165, 182, or 196 in the manager information is changed in accordance 25 with FIG. 12 or 13 so as to indicate that the decode program is present on the information recording medium (ST8). If the corresponding decode program is already

present on the information recording medium, the decode program need not be received from the data input section 6 and recorded on the information recording medium.

5 The audio object received from the digital audio input section 4 is formatted into the audio recording standard and recorded in the AR_AUDIO.ARO 212 in accordance with the standard (ST9). When recording of the audio object is ended, the manager information in
10 the MAIN MPU section 30 is changed and recorded in the AR_MANGR.IFO 211 (ST10), thus ending the series of recording operations.

 Reproduction processing by the information recording/reproduction apparatus will be described next
15 with reference to FIG. 2.

 First, manager information recorded on the information recording medium 100 through the disc drive section 1 is temporarily stored in the temporary storage section (work RAM) 2 in the MAIN MPU
20 section 30. Using the manager information in the temporary storage section 2, a video object, audio object, and the like recorded on the information recording medium are read out. If the audio object is a compressed content, a decode program corresponding to
25 the compression scheme is loaded from the information recording medium to the program area 17 of the programmable DSP LSI 16. The audio object to be

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reproduced is decoded using the programmable DSP LSI 16. The video object is decoded by the video decoding section 22. These decoded objects are output from the digital audio output section 27, analog audio output section 26, or analog video output section 28 to a TV, amplifier, or speaker.

FIG. 9 is a flow chart showing the reproduction operation by the information recording/reproduction apparatus.

First, the information recording/reproduction apparatus loads manager information recorded on the information recording medium for the AR_MANGR.IFO 211 to the MAIN MPU section 30 (ST11). The attribute of an audio object to be reproduced is checked using the manager information (ST12). When the audio object is an uncompressed linear PCM audio (A_ATR 180 = 0000 0000b) (NO in ST12), the audio object can be read out from the AR_AUDIO.ARO 212 and reproduced without any decoding operation (ST20, ST21, and ST22).

If the audio object to be reproduced is a compressed object (YES in ST12), and if a decode program for decoding this compression scheme is stored in the program area 17 of the DSP LSI 16 (YES in ST13), the compressed object read out from the AR_AUDIO.ARO 212 can be decoded using the DSP LSI 16 (ST19) to reproduce the audio object (ST20, ST21, and ST22).

If the decode program for decoding the compressed

object has not been stored in the program area of the
DSP LSI 16 (NO in ST13), it is checked using
information in the DEC_PG 165, 182, or 196 whether
the decode program is present in the AR_DECOD.PRG 215
5 on the information storage medium (ST14). Even if
the decode program is not present (NO in ST14), if a
hardware decoder corresponding to the compressed object
is present in the information recording/reproduction
apparatus (YES in ST15), the audio object can be
10 reproduced using the decoder (ST19, ST20, ST21, and
ST22). If neither the decode program nor the hardware
decoder is present (NO in ST15), the audio object
cannot be decoded (ST16).

When the decode program is present in the
15 AR_DECOD.PRG 215 on the information recording medium
(YES in ST14), i.e., when data representing the
presence of the decode program is recorded in the
DEC_PG 165, 182, or 196, the corresponding decode
program is loaded from the AR_DECOD.PRG 215 to the
20 program area 17 of the DSP LSI 16 (ST17). The
compressed object read out from the AR_AUDIO.ARO 212
can be decoded using the DSP LSI 16 (ST18, ST19, ST21,
and ST22).

The present invention will be summarized below.

25 (1) A provider for providing a compressed content
by electronic distribution or the like transmits
a decode program for decoding the compressed data

together with the compressed data if the receiver has no means for decoding the compressed data.

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5 (2) An information recording/reproduction apparatus records a decode program for decoding compressed data on an information recording medium together with the compressed data. The apparatus also records information for managing the correspondence between the compressed data and the decode program.

10 (3) An information recording medium has areas for recording a plurality of data compressed by different compression schemes and a plurality of different decode programs for decoding these data. The medium also has an area for recording information for managing the compressed data and decode programs.

15 (4) An information recording/reproduction apparatus has a programmable DSP LSI for decoding a plurality of different decode programs. First, a necessary decode program is written from the information recording medium to the program area of the
20 DSP LSI. Then, compressed data on the information recording medium is decoded using the DSP LSI.

25 Additional advantages and modifications will readily occur to those skilled in the art. Therefore, the invention in its broader aspects is not limited to the specific details and representative embodiments shown and described herein. Accordingly, various modifications may be made without departing from the

spirit or scope of the general inventive concept as defined by the appended claims and their equivalents.

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